

NASA Science Mission Directorate - Applied Sciences Program

Aviation – Fiscal Year 2005 Annual Report^{*}



SUMMARY

The Aviation program element continued its progress in FY2005, including major presentations on Aviation Safety Action Program (ASAP) research, benchmarking, and integration activities presented at the *11th American Meteorological Society (AMS) Conference on Aviation, Range, and Aerospace Meteorology* and the *22nd AMS Conference on Severe Local Storms*. The Aviation program reported on the detection and characterization of aviation weather constraints and hazards, including in-flight icing, convective weather, aviation turbulence, volcanic ash or gas, and oceanic winds. Extensive publications and presentation of ASAP applications and benchmarks continued throughout 2005 with particular saturation at the *International Symposium on Nowcasting and Very Short Range Forecasting (WSN05)* in September 2005. In FY06, the program will present its further progress at AMS conferences, and the program plans to commence activities to extend research results from the increasingly important issue of space weather effects on aviation.

In FY05, the NASA Aeronautics Research Mission Directorate (ARMD) concluded its 5-year Aviation Safety and Security Program (AvSSP), which served as a stalwart partner to the NASA Applied Sciences Program during the planning, implementation and execution of the initial phase of the Aviation program. ARMD AvSSP was particularly instrumental in fomenting a close professional relationship between Aviation program management and the FAA Aviation Weather Research Program, the Office of the Federal Coordinator for Meteorology, and the interagency Joint Planning and Development Office (JPDO) for the Next Generation Air Transportation System. The Aviation program is particularly proud that AvSSP awarded 12 trophies and 34 certificates for superior aeronautics research to the Applied Sciences Program director, the Aviation program manager and deputy, and various ASAP PIs, researchers and their affiliated laboratories (including NASA-Langley, National Center for Atmospheric Research (NCAR), University of Alabama–Huntsville, MIT Lincoln Laboratory, NOAA Forecast Systems Laboratory, and University of Wisconsin–Cooperative Institute for Meteorological Satellite Studies). In addition, the Aviation program received a NASA Group Achievement Award in June 2005.

MAJOR ACCOMPLISHMENTS

ASAP Research and Applications Accomplishments (with NASA ARMD/AvSSP)

ASAP began the integration of ASAP cloud microphysical properties derived from NOAA GOES spacecraft into the operational Current Icing Potential product and is examining the potential operational use of products derived from MODIS. The program published a benchmark report on in-flight icing in October 2005, meeting FY05 IBPD metrics 5ESA2, 5ESA6, and 5ESA7. The NASA ARMD awarded a three-year grant to ASAP in 2005 for the use of the Project Columbia Supercomputer for the integration of NASA ASAP icing applications into the NOAA Current Icing Potential forecast product.

ASAP's satellite-based convective initiation products were integrated into NCAR's Auto Nowcast System, and FAA conducted testing on them at the Chicago O'Hare International Airport. Convective weather, with its concomitant impacts on aviation safety and efficiency, is the most significant hazardous weather factor tracked and reported through the National Airspace System. The convective weather

^{*} The FY05-09 Aviation Program Element Plan is available through: <http://aiwg.gsfc.nasa.gov/dss.html>

products rely on Earth science satellite observations from NASA MODIS and NOAA GOES data. Planned enhancements for these products include hyperspectral sounding observations from the next-generation NOAA GOES-R satellite.

NASA began support of the observation and decision support system requirements outlined in the JPDO National Aviation Weather Strategy, advocating on the JPDO's behalf in conjunction with NASA's efforts with the U.S. Group on Earth Observations (USGEO). This activity includes support for the development of aviation weather observing system requirements to underpin the Next Generation Air Transportation System. Earth-Sun system science research activities focus on integrating current ASAP activities with FAA and NOAA efforts in support of the JPDO.

ISSUES FOR FY06

In FY06, the NASA Aeronautics Research Mission Directorate expects to re-plan its three core programs in Aviation Safety, Airspace Systems, and Fundamental Aeronautics. Many aspects of these programs are being formulated to ensure the success of the national initiative being undertaken by the interagency JPDO. The JPDO Aviation Weather Integrated Product Team (IPT) is tasked with developing an integrated aviation weather observing and forecast system that will be able to handle the capacity and safety requirements of the National Airspace System of 2025, which is expected to more than triple in size. The Aviation program has undertaken a major role in the JPDO Weather IPT and contributes a significant number of members to its various sub-teams, including the chairs of the Observations and Sensors sub-teams. During FY06 the Aviation program will continue to strengthen its ties with ARMD, JPDO, FAA, NOAA, and affiliated research institutions to further enhance the societal impact of Earth science observations and research results in support of national aviation priorities.

SOLICITATIONS

Decisions CAN

The Aviation Program received 12 Step-1 proposals in the Decisions CAN and encouraged 11 to submit full proposals. In Step-2, the Aviation program received 12 full proposals.

Following the panel reviews and internal assessment for programmatic balance, the Applied Sciences Program selected the following Aviation proposals for awards:

Improvement of Operational Aircraft Icing Forecasts and Diagnoses by Assimilation of Satellite Cloud/Surface Properties in the RUC/WRF

PI: Patrick Minnis, NASA Langley Research Center

Near Real-time NASA Volcanic Cloud Data for NOAA, FAA, and USGS Decision Support Systems

PI: Arlin Krueger, University of Maryland–Baltimore County

The program selected the following proposals for a single, combined project:

Decision Support for Aircraft Avoidance of Convectively-Induced Turbulence Due to Thunderstorms

PI: Robert Sharman, National Center for Atmospheric Research

Satellite-Based Prediction of Clear Air Turbulence Associated with Tropopause Folds and Unbalanced Upper-Level Fronts

PI: Steven Koch, NOAA

The Applied Sciences Program later selected additional proposals for one-year awards from a Congressionally-directed augmentation, including one project for the Aviation program's portfolio:

Oceanic Convective Weather Diagnosis and Nowcasting
PI: Cathy Kessinger, National Center for Atmospheric Research

ROSES 2005 – Section A.24

For the Applied Sciences portion of the ROSES 2005 NRA, the Aviation Program received 7 Step-1 proposals and encouraged all 7 to submit full proposals. The Step-2 proposals were due in November 2005 with selections expected by April 2006.

PUBLICATIONS (SELECTED)

Haynes, John A. and John Murray, "NASA Space Systems Enhance Aviation Science for Society," *Earth Observation Magazine*, publication pending.

Lane, T.P., J.D. Doyle, R. Plougonven, M.A. Shapiro, R.D. Sharman, "Observations and numerical simulations of inertia-gravity waves and shearing instabilities in the vicinity of a jet stream," *Journal of the Atmospheric Sciences*, 61, 2692-2706.

CONFERENCE/WORKSHOP PRESENTATIONS AND POSTERS (SELECTED)

Ackerman, S. A., M. Richards and W. F. Feltz 2004: "Estimating the height of volcanic plumes from the 15 micron CO₂ band," American Geophysical Society, 13-17 December 2004, presentation.

Avery, M.A., J. J. Murray, J. V. Plant, T. Hock, E. Korn and C. Martin, "Water Vapor, Temperature and Ozone Measurements and Variability: Preliminary Case Studies from the North Atlantic THORPEX Regional Campaign," *First THORPEX Science Symposium*, Montreal, 2004.

Bedka K.M., W. F. Feltz, J. R. Mecikalski, R. A. Petersen, and C. S. Velden, "Statistical relationships between satellite-derived mesoscale atmospheric motion vectors and NOAA wind profiler network observations," *12th Conference on Aviation, Range, and Aerospace Meteorology*, 30 January-2 February, 2006. Atlanta, Georgia.

Bedka, K. M. and J. R. Mecikalski, 2005: Multi-Sensor Convection Analysis. *5th Annual Workshop on Hyperspectral Science of UW-Madison MURI, Airborne, LEO, and GEO Activities*, Madison, WI.

Bedka, K. M., J. R. Mecikalski, and W. F. Feltz, "Analysis of cumulus cloud motion and growth toward nowcasting convection and lightning initiation," *CIMSS 25th Anniversary Symposium on Satellite Meteorology: Past, Present and Future*. 11-13 July 2005, Univ. of Wisconsin-Madison, Madison, Wisconsin.

Bedka, S. T., W. F. Feltz, A. J. Schreiner, and R. E. Holz, "ASAP CONUS Cloud Top Height Validation," *ASAP Science Meeting*, 13-14th April 2005.

Bedka, K. M., J. R. Mecikalski, S. J. Paech, T. Berendes, and U. Nair, 2004, "Forecasting convective initiation by monitoring the evolution of moving cumulus in daytime GOES imagery," *11th Conf. on Aviation, Range, and Aerospace Meteorology*, and *22nd Conf. on Severe Local Storms*, Hyannis, MA.

Berendes, T., and J. Mecikalski, 2005, "Detection of convective clouds and volcanic ash in satellite imagery using an iterative statistical clustering method," *International Symposium on Nowcasting and*

Very Short Range Forecasting (WSN05), Meteo-France, Toulouse, France, 5-9 September 2005.

Feltz, W. F., J. R. Mecikalski, J. J. Murray, D. B. Johnson, K. Bedka, S. M. Bedka, S. M. Thomas, A. J. Wimmers, M. Pavolonis, S. Ackerman, M. Richards, and N. Ulhenbrock, 2005, "Satellite-derived Aviation Hazard Products at the University of Wisconsin: Convection, Turbulence, Volcanic Ash, and Winds," Proceedings from the *World Weather Research Program Symposium on Nowcasting*, Toulouse, France, 5-9 September 2005

Feltz, W. F., 2005, "LEO/GEO Applications for Aviation," *5th Annual Workshop on Hyperspectral Science of UW-Madison MURI, Airborne, LEO, and GEO Activities*, Madison, WI.

Feltz, W. F., J. R. Mecikalski, J. J. Murray, D. B. Johnson, K. M. Bedka, S. M. Thomas, A. J. Wimmers, S. A. Ackerman, and C. C. Schmidt, "The Advanced Satellite Aviation-weather Products (ASAP) initiative at the University of Wisconsin – CIMSS," *21st IIPS Conference*, San Diego, CA, 9-13 January 2005, preprints, poster presentation.

Feltz, W. F., J. J. Murray, K. M. Bedka, S. M. Bedka, M. Pavolonis, A. J. Wimmers, S. A. Ackerman, M. S. Richards, and N. L. Uhlenbrock, 2005, "Satellite-based Aviation Weather Applications for Convection, Visibility, Turbulence, and Volcanic Ash," *CIMSS 25th Anniversary Symposium*. 11-12 July 2005
Madison, WI.

Feltz, W. F., J. R. Mecikalski, J. J. Murray, D. B. Johnson, K. M. Bedka, S. M. Thomas, A. J. Wimmers, and C. C. Schmidt, 2004, "The Advanced Satellite Aviation-Weather Products (ASAP) initiative at the University of Wisconsin – CIMSS," Preprints, *13th Conf. on Satellite Meteorology and Oceanography*.

Wimmers, A. and W. Feltz, "Estimating Regions of Tropopause Folding and Clear-Air Turbulence with GOES Water Vapor Channel," Proceedings from the *World Weather Research Program Symposium on Nowcasting*, Toulouse, France, 5-9 September 2005.

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